Radio
Tube Transmitter

TYPE
T.F.

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STYLE
325996

MANUFACTURED BY
Westinghouse Electric & Manufacturing Company
FOR

· Radio Corporation of America ·

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TF

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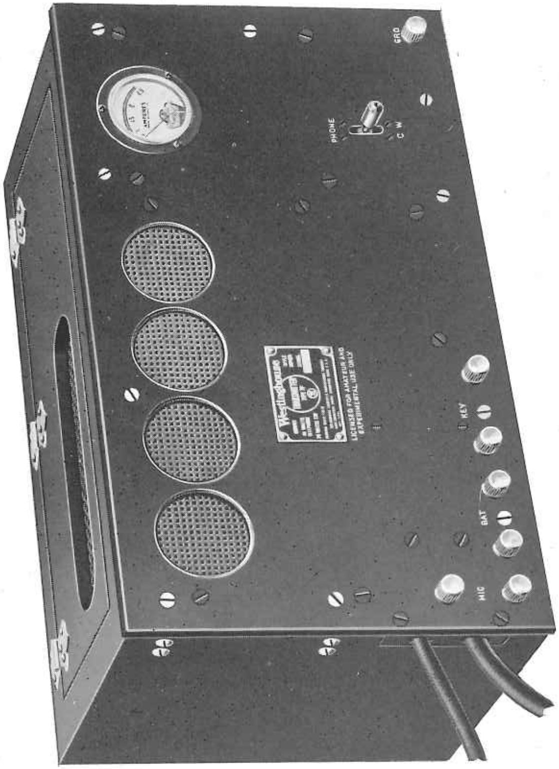

Fig. 1—Radio Tube Transmitter—A-C. Model

Radio Tube Transmitter

INTRODUCTION

The type TF tube transmitter is a radio telegraph and telephone transmitter designed for general amateur use and for experimental purposes. It employs four 5 watt vacuum tubes with suitable auxiliary apparatus, most of which is enclosed in a neat cabinet having a bakelite panel. When telegraphing, the circuit is such that all four tubes are operated in parallel as oscillators and the set then has a nominal output rating of 20 watts. When telephoning, a modification of the constant current system of modulation is used so that two tubes operate as modulators while the other two operate as oscillators giving a nominal rating of 10 watts. The necessary change of connections is made by one switch of the anti-capacity type.

FOR ALTERNATING-CURRENT POWER SUPPLY

Equipment:

The standard equipment furnished under style 325996 consists of the following four items:

1. Tube transmitter in cabinet style 307454-A.
2. Telegraph key, style 319557
3. Desk microphone, style 319556.
4. Model UV-202 Radiotron vacuum tubes. (Four)

In addition to the above apparatus, the following will be required.

1. Motor generator set, style 307212.
2. Suitable antenna, counterpoise and ground.
3. 6 volt storage battery or 5 dry cells in series.
4. Suitable power supply at approximately 110 volts, 60 cycles.

INSTALLATION

General:

Assuming that an entirely new installation is to be made, the following quotations from the National Electrical Code will be of value.

RADIO INSTALLATION RULES

In setting up radio equipment all wiring pertaining thereto must conform to the general requirements of the National Electrical Code for the class of work installed and the following specifications.

FOR TRANSMITTING STATIONS

Antenna:

Antennas outside of buildings shall not cross over or under electric light or power wires of any circuit of more than six hundred (600) volts or railway trolley or feeder wires, nor shall it be so located that a failure of either the antenna or of the above mentioned electric light or power wires can result in a contact between the antenna and such electric light or power wires.

Antennas shall be constructed and installed in a strong and durable manner and shall be so located as to prevent accidental contact with light or power wires by sagging or swinging.

Splices and joints in the antenna span shall, unless made with approved clamps or splicing devices, be soldered.

Lead-in Wires:

Lead-in wires shall be of copper, approved copper-clad steel or other metal which will not corrode excessively and in no case shall they be smaller than No. 14 B & S gage.

Antenna and counterpoise conductors and wires leading therefrom to ground switch, where attached to buildings, must be firmly mounted five (5) inches clear of the surface of the building or non-absorptive insulating supports such as treated wood pins or brackets equipped with insulators having not less than five (5) inch creepage and air-gap distance to inflammable or conducting material. Where desired approved suspension type insulators may be used.

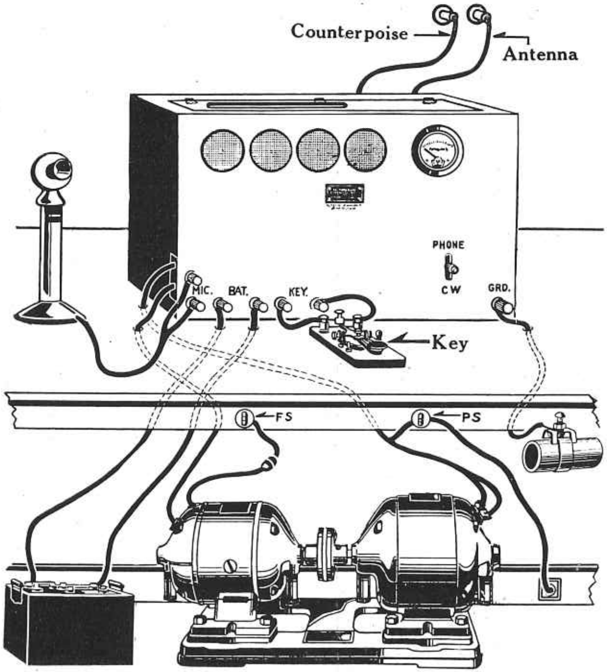

Fig. 2—Radio Tube Transmitter—Installed

In passing the antenna or counterpoise lead-in into the building a tube or bushing of non-absorptive insulating material shall be used and shall be installed so as to have a creepage and air-gap distance of at least five (5) inches to any extraneous body. If porcelain or other fragile material is used it shall be installed so as to be protected from mechanical injury. A drilled window pane may be used in place of bushing provided five (5) inch creepage and air gap distance is maintained.

Protective Grounding Switch:

A double throw knife switch having a break distance of four (4) inches and a blade not less than one eighth (1/8) inch by one half (1/2) inch shall be used to join the antenna and counterpoise lead-ins to the ground conductor. The switch may be located inside or outside the building. The base of the switch shall be of non-absorptive insulating material. Slate base switches are not recommended. This switch must be so mounted that its current carrying parts will be at least five (5) inches clear of the building wall or other conductors and located preferably in the most direct line between the lead-in conductors and the point where ground connection is made.

Protective Ground Wire:

Antenna and counterpoise conductors must be effectively and permanently grounded at all times when the station is not in actual operation (unattended) by a conductor at least as large as the lead-in conductor and in no case shall it be smaller than No. 14 B & S gage copper or approved copper clad steel. This ground wire need not be insulated or mounted on insulating supports. The ground wire shall be run in as straight a line as possible to a good permanent ground. Preference shall be given to water piping. Gas piping shall not be used for the ground connection. Other permissible grounds are the grounded steel frames of buildings and other

grounded metal work in buildings and artificial grounding devices such as driven pipes, plates, cones, etc. The ground wire shall be protected against mechanical injury. An approved ground clamp shall be used wherever the ground wire is connected to pipes or piping.

Operating Ground Wire:

The radio operating ground conductor shall be of copper strip not less than three-eighths (3/8) inch wide by one sixty-fourth (1/64) inch thick, or of copper or approved copper-clad steel having a periphery, or girth (around the outside) of at least three quarters (3/4) inch (for example a No. 2 B & S gage wire) and shall be firmly secured in place throughout its length. The radio operating ground conductor shall be protected and supported similarly to the lead-in conductors.

Operating Ground:

The operating ground conductor shall be connected to a good permanent ground. Preference shall be given to water piping. Gas piping shall not be used for ground connections. Other permissible grounds are grounded steel frames of buildings or other grounded metal work in the building and artificial grounding devices such as driven pipes, plates, cones, etc.

Power From Street Mains:

When the current supply is obtained directly from street mains, the circuit shall be installed in approved metal conduit, armored cable or metal raceways.

If lead-covered wire is used it shall be protected throughout its length in approved metal conduit or metal raceways.

Protection From Surges, Etc.:

In order to protect the supply system from high potential surges and kick-backs there must be installed in the supply line as near as possible to each radio transformer, rotary spark gap, motor in generator sets and other auxiliary apparatus one of the following:

1. Two condensers (each of not less than one half (½) microfarad capacity and capable of withstanding a six hundred (600) volt test) in series across the line and midpoint between condensers grounded; across (in parallel with) each of these condensers shall be connected a shunting fixed spark gap capable of no more than one thirty second ($\frac{1}{32}$) inch separation.
2. Two vacuum tube type protectors in series across the line with the midpoint grounded.
3. Non-inductively wound resistors connected across the line with midpoint grounded.
4. Electrolytic lightning arresters such as the aluminum cell type.

In no case shall the ground wire of surge and kick-back protective devices be run parallel with the operating ground wire when within a distance of thirty (30) feet.

The ground wire of the surge and kick-back protective devices shall not be connected to the operating ground or ground wire.

Suitable Devices:

Transformers, voltage reducers, keys, and other devices employed shall be of types suitable for radio operation.

ANTENNA AND COUNTERPOISE CONSTRUCTION

Select a location for the antenna and counterpoise as free from trees, buildings or other objects as possible. Such objects near either the antenna or counterpoise absorb energy which detracts from the energy radiated. Nothing should be allowed nearer than 10 feet, except at the ends, and this clearance should be increased to as much as possible.

Any convenient supports for the antenna and counterpoise may be used. Frequently buildings are so located that it is convenient to attach the antenna near the eaves and the counterpoise lower down. Other suitable supports are trees, poles or towers. If trees are used, select the largest one available and attach to the trunk so that the end of the antenna or counterpoise will not swing. One end of the antenna should be attached to a weight over a pulley or a spring as otherwise the tree is almost sure to break the wire when blown by the wind. The antenna conductors should not be allowed to extend in among the branches of the tree. Insulators should be inserted about 10 feet from the branches and supporting wires run the rest of the way. If an artificial support is to be used, either a pole or a tower may be erected. It should be securely guyed to prevent swaying.

The antenna should consist of two parallel wires from 60 to 80 feet long, separated horizontally by wooden spreaders 3 to 4 feet long. It should be supported from 25 to 50 feet above the ground. The counterpoise should consist of a similar structure as near the ground as convenient in order to make the distance between it and the antenna as great as possible. Nothing should be allowed to intervene between the antenna and counterpoise as it will

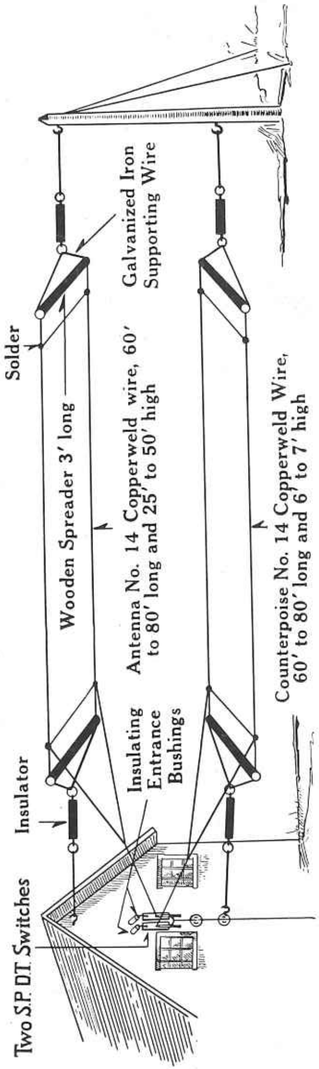
Solder
Wooden Spreader 3' long
Antenna No. 14 Copperweld wire, 60' to 80' long and 25' to 50' high
Galvanized Iron Supporting Wire
Counterpoise No. 14 Copperweld Wire, 60' to 80' long and 6' to 7' high
Insulating Entrance Bushings
Insulator
Two S.P. D.T. Switches

Fig. 3—Antenna

partially destroy the effectiveness of the latter. The counterpoise should be as nearly as possible directly under the antenna. Fig. 3 shows a possible arrangement.

The best wire for the antenna and counterpoise is No. 14 B & S gage copper or copper-clad steel. The latter is stronger and should be used for extra long spans or where a heavy accumulation of ice is likely. There is little to be gained in the use of a larger size of wire. Insulators must be mechanically strong, of good electrical quality and designed to withstand high voltages. The material should have a surface that will not absorb moisture or be otherwise affected by the weather. The spreaders should be light but strong. Wood suitably protected against the weather is suitable. Leads from the antenna and counterpoise should be of No. 14 B & S gage wire (same as antenna wire) and should be firmly fastened to prevent swaying. All joints should be mechanically strong and should be soldered to prevent corrosion and poor contact.

The ground switches should preferably be located on the outside of the building and should be mounted near a door or window where they can be easily reached. Do not use a slate base switch as this material is a poor insulator at high frequency and the operation of the set is likely to be unsatisfactory. The lead-ins should be connected to the center contacts of the switches. The protective ground wires should be connected to the lower contacts. The wires from the apparatus should be connected to the upper contacts. The bushings through the wall of the building should slope outward. All features of the installation should conform to the National Electrical Code rules.

The set should be located as near the lead-in as possible. It should be placed at the back of a table or bench of convenient height so that the operator may have a place to write and to rest his arm while sending. Sufficient space should also be allowed for the receiving set which should be within convenient reach. The microphone battery may be placed under the table or elsewhere and may be the same one that is used for filament heating of the tubes in the receiving set. The motor generator should preferably be near the transmitter unless its noise is objectionable in which case it may be placed in another room. It is usually convenient to silence it as much as possible by placing it on a thick felt cushion or by placing rubber sponges under each corner of the bed-plate.

Connections:

Remove the ten nickel-plated screws near the edge of the panel. This will permit the panel and all the apparatus, which is mounted on it, to be removed from the cabinet.

Pass the high voltage cord (the one emerging from the lower hole in the frame) from the generator through the upper hole in the micarta block and through the metal clip as shown in Fig. 5. Connect the wires to the high voltage terminals making sure that the wire marked + is connected to the terminal marked + and that the wire marked – is connected to the terminal marked –. Failure to observe this point will prevent the set from operating.

Determine the approximate voltage and frequency of the alternating-current power supply. The frequency must be between 50 and 60 cycles and the voltage must be between 105 and 115. Connections are made at the factory for 110 volts. If voltage is nearer 105, remove wire from terminal (3) and connect to terminal (2). If voltage is nearer 115 connect wire (5) to terminal (4). See Fig. 5.

Connect filament supply cord (E) in parallel to cord leading to motor on the motor side of switch (PS). Be sure that switch is in off position. Connect both cords to a base board receptacle plug in such a way that the switch will control both the filament and motor circuits. Insert plug in receptacle. Further instructions for the care and operation of the motor generator are furnished with it.

Run counterpoise lead through bushing in rear of cabinet and connect it to the proper binding post at the top of the inductance coil. Do the same for the antenna lead. The ground wire is not to be connected until after preliminary tests.

Connect microphone, battery and key to the proper binding posts on the front of the panel. Open the circuit closing switch on the key and work the lever several times to see that relay in cabinet operates properly. Adjust the motion of the hand key until it suits you.

Note the position of each of the clips on the inductance coil and compare it with what is given for the same clips in the following table:

Clip marked GRD (ground) approximately at center of coil.

Clip marked CWG (continuous wave grid) approximately 5 turns down from turn connected to ground.

Clip marked CTPS (counterpoise) approximately 6 turns down from turn connected to ground.

Clip marked MG (modulator grid) approximately 9 turns down from turn connected to ground.

Clip marked ANT (antenna) approximately 6 turns up from turn connected to ground.

Clip marked CWP (continuous wave plate) approximately 7 turns up from turn connected to ground.

Clip marked MP (modulator plate) approximately 13 turns up from turn connected to ground.

If any of the clips have fallen off or are out of place, make the necessary correction according to this table.

Adjustment:

Open field switch (FS). This will allow the generator to produce about 350 volts when running. Close the power supply switch (PS). The motor generator should start and all the tube filaments should light to full brilliancy. If any tube does not light, ascertain why and if necessary replace it with a good tube. While the motor generator is running, it is advisable not to touch any of the apparatus behind the panel because there is 350 volts difference of potential between some parts.

Move the communication switch to the "CW" position and press the key for an instant noting whether or not the antenna ammeter needle deflects. If it does, it indicates that the set is oscillating. Hold the key down and measure the wave length with a wave meter making sure that it corresponds to the wave length assigned in the station license. If the needle of the ammeter does not deflect, it is an indication that the set is not oscillating. Check all connections and make sure that the antenna and counterpoise are connected to the set. If the set still does not oscillate, move clips "CWP" and "MP" up a turn or two and clips "CWG" and "MG" down a turn or two and try again. Keep on adjusting these clips until the set does oscillate.

If the measured wave length is too high, move the clip "CTPS" up one or two turns and the clip "ANT" down one or two turns. Again measure the wavelength and readjust until the correct wave length is obtained. If the ammeter shows less than

1.5 amperes and the tube plates show no color due to heating, move the clip "CWP" down a turn at a time until the ammeter shows maximum current and the tube plates show no color. If the tube plates show a red color due to heating, move clip "CWP" up until color disappears. Then adjust clip "CWG" for maximum antenna current.

Note: No adjustments should be made while the generator is running. Always turn off the power and wait for the generator to come to rest. Otherwise a disagreeable shock may be experienced.

Now move the communication switch to the "Phone" position. Close the circuit closing switch on the key and note the ammeter reading. If it is less than 0.8 amperes and the oscillator tubes (two tubes nearer the inductance coil) show no color due to heating, move clip "MP" down until maximum current in the ammeter is obtained with the tubes showing no color. If the oscillator tubes show red color, clip "MP" should be moved up until this color disappears. Clip "MG" should then be adjusted for maximum ammeter reading. If the modulator tube plates (two tubes further from inductance) show color due to heating, move the modulator grid bias clip to top tap on grid bias resistance. Check modulation by noting that ammeter reading increases slightly when speaking into microphone.

If it is desired to use the high voltage of the generator, close the field switch. Move clips "CWP" up three or four turns and clip "MP" up six or eight turns. Place grid bias clip on uppermost tap of resistance. Move clips "CWG" and "MG" up one or two turns and proceed as already explained except that in the "CW " position of the communication switch, the ammeter reading should be not less than 2 amperes, while in the "Phone" position it should be not less than 1.25 amperes.

Connect ground wire to proper post and see that it makes no difference in the ammeter reading. If ammeter reading decreases when ground wire is connected, move both clips marked "CTPS" and "ANT" up a turn or two or down a turn or two until a point is reached where the ammeter reading will not be changed.

In some cases it may not be possible to use a counterpoise although in general it is advisable because of the higher efficiency that can be obtained with one. If the counterpoise is omitted, the tuning process will be similar to that described except that the ground wire should be connected to the clip marked "GRD" at first and left there. It will probably be necessary to move clips "CWG" and "MG" down three or four turns further than with the counterpoise and it may be necessary to move clips "CWP" and "MP" up one or two turns to get maximum ammeter reading with the tube plates operating below a temperature high enough to show a red color. Of course, clip "CTPS" has no function and may be removed.

After all adjustments have been made and it is determined that the set is operating satisfactorily, it may be replaced in the cabinet for protection.

FOR DIRECT-CURRENT POWER SUPPLY

Equipment:

The standard equipment furnished for operation from a source of direct-current, consists of the following four items:

1. Tube transmitter in cabinet, style 307754-A.
2. Telegraph key, style 319557.
3. Desk microphone, style 319556.
4. 4 Model UV-202 Radiotron vacuum tubes.

In addition to the above apparatus, the following will be required:

1. Special Motor Generator Set.
2. Suitable Antenna, counterpoise and ground.
3. 6 Volt storage battery or 5 dry cells in series.
4. Suitable direct-current power supply.

Installation:

The same directions previously given for the alternating current model apply equally well to the direct-current model.

Connections:

After removing the panel and apparatus as previously described, pass the high voltage cord through the upper hole in the micarta block and attach the wires to the high voltage terminals, making sure that the wire marked + is connected to the terminal marked + and that the wire marked — is connected to the terminal marked—. Failure to observe this point will prevent the set from operating.

Attach the filament leads from the set to the low voltage binding posts on the generator. If the filament voltmeter deflects backwards interchange the filament leads. Turn the filament rheostat as far to the left as possible.

Connect the leads from the motor through a switch to a base board receptacle plug. Be sure that the switch is open. Insert the plug in the receptacle. Further instructions for the care and operation of the motor generator are furnished with it.

Other connections are to be made as described under the alternating-current model.

Adjustment:

When all connections have been made, close the power switch. The motor generator should then start and the filaments should light dimly. The

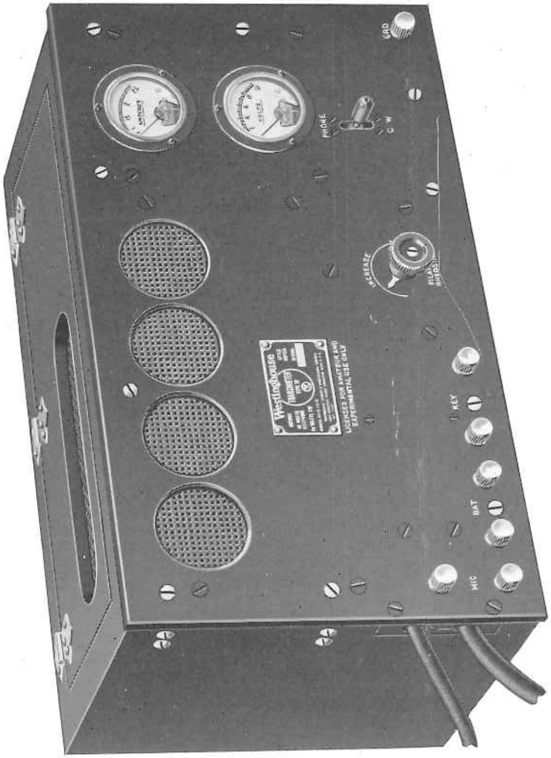

Fig. 4—Radio Tube Transmitter—D-C. Model

voltmeter on the panel is connected to the filament circuit and measures the voltage across the filaments. The filament rheostat should then be turned to the right until the voltmeter reads 7.5 volts. Further directions for adjustment are the same as for the alternating-current model except that only one high voltage, about 425, is available from the generator.

SECTION 2

ELECTRICAL DESCRIPTION

A-C. Power Supply

The TF transmitter is a short wave, continuous wave transmitter designed particularly for amateur use at approximately 200 meter wavelength. It uses vacuum tubes as a source of radio frequency current and as a means of modulating the output when telephony is used. It is arranged to take its main power supply from the usual 110 volt, 60 cycle alternating-current service and also requires a source of direct-current at 6 volts to operate the key relay and the microphone.

Fig. 1 is a front view of the set showing the panel. Figs. 5 and 6 are views showing the apparatus which is mounted on the back of the panel. Fig. 7 is a diagram of connections which is drawn in such a way that the various parts are located in the same relative positions as in the set. (A) and (B) are the four vacuum tubes which are of the 5 watt size. Radiotron Model UV-202 being satisfactory. They are mounted in standard sockets, side by side. The filaments of all four tubes are connected in parallel and the filament heating current is supplied by the filament transformer (C). Allowance is made for variations in supply voltage by three taps on the primary of the filament transformer for 105,110 and 115 volts, these being numbered from 1 to 4, number 1 being the common terminal and the other taps being arranged as shown. Connection to the filament transformer is made by a flexible cord (E) which passes out at the left end of the box. A resistor (D) with a center tap is connected across the secondary of the filament transformer. This center tap provides a return point to the filament circuit at a point where the potential may be considered fixed. This center point is connected directly to the "Ground" binding post and from there to the "GRD' clip on the coupling coil (U). Further connection is made to one of the contacts of the relay (L) and through it to a tap on a bias resistor (J) and then to the negative lead from the high voltage generator. A condenser (K) is connected across the relay contacts to minimize sparking. Connection to the high voltage generator is made by a flexible cord (F) which is attached to two binding posts, the polarity of both leads and binding posts being marked. A condenser (G) is connected directly across the generator leads and serves as a filter. From the positive lead, connection is made to the plate transformer (H) where the circuit divides into two branches. One branch goes through a radio frequency choke coil (V) to the plates of tubes (A) which are permanently connected in parallel. The other branch goes through the radio frequency choke coil (W) to the plates of tubes (B) which are also permanently in parallel. Connection is made from the plates of tubes (A) through the plate stopping condenser (P) to the second switch blade on the communication switch (S) which is of the anti-capacity type. From there, connection is made to the "CWP" clip when the switch is in the "CW" position and to the "MP" clip when the switch is in the "Phone" or modulated position. Another connection is also made to one of the contacts on the upper set, the switch blade of which is connected to the plates of tubes (B) so that

in the "CW" position of communication switch (S) the plates of all four tubes are connected in parallel. Connection is made from the grids of tubes (A) through the grid condenser (Q) and the grid leak (R), which are connected in parallel, to the lower switch blade of the communication switch (S) and from there to either the "MG" or "CWG" clips on the loading coil (U). Another connection is made from the grids to one of the third set of contacts. The other contact of the same set is connected to one end of the secondary of the modulation transformer (N). The switch blade is connected to the grids of tubes (B) so that when switch (S) is in the "CW" position, the grids of all four tubes are connected in parallel. In the "Phone" position, the grids of tubes (B) are connected to one end of the secondary of the modulation transformer (N). The other end of the secondary is connected to the negative generator lead, the necessary bias being provided by the flow of plate current through the resistor (J). The primary of the modulation transformer (N) is shunted by a resistor (O) and the circuit is completed through the microphone, the battery and the key. The operating circuit of the relay (L) is completed through the resistor (M), the key and the battery. The key is provided with a short circuiting lever which must be closed when the set is used for telephony. The microphone is a standard piece of telephone apparatus and is furnished with a desk stand. Connection is made from the antenna post through the thermo-couple ammeter (T) to the "Ant" clip while the counterpoise is connected directly to the "CTPS" clip, the circuit being completed through the loading coil.

Fig. 10 shows the connections for the direct-current model. These connections differ from those shown in Fig. 7 in the following instances: The filament heating current is obtained from a low voltage winding on the generator which supplies approximately 9 volts, through the flexible cable (Y). The filament current is regulated by the rheostat (X). A voltmeter (Z) is provided to measure the voltage applied to the filaments, this being the approved method of regulating filament current. The voltmeter will read backwards unless the polarity of the filament supply is correct.

To show more clearly the way in which the TF transmitter operates, Figs. 11 and 12 are included.

Fig. 11 is a schematic diagram of connections for telegraphy. It will be seen that this differs little from the usual circuit. The popular Hartley oscillating circuit is used to provide the coupling between grid, plate and antenna. A thermo-couple ammeter is placed in the antenna lead and is the only instrument provided with the set. Keying is obtained by placing a relay in the plate return lead. This method is the best as it entirely cuts off the plate current during the non-signalling periods. The relay has to break full plate voltage so is shunted by a condenser to reduce arcing. The relay is operated by the battery and usual telegraph key. The condenser (G) removes most of the generator noise from the transmission.

Fig. 12 is a schematic diagram of connections for telephony. The system of modulation is a modification of that known as the Heising or constant current system. It really is a system for varying the plate voltage to the oscillator tube. In the TF transmitter, this is accomplished through the plate transformer (H). With a given plate voltage, the plate current of the modulator tube will vary with its grid potential. The grid is maintained at an average bias by the drop through resistance (J)

while its instantaneous potential is varied by potentials superposed by the microphone transformer (N) on the average bias. If adjustments are properly made, the plate current of the modulator will assume a shape similar to the sound waves directed into the microphone. The plate transformer (H) is so connected that when the modulator plate current increases, a potential adding to the generator potential is induced in the other winding so that the effective potential applied to the plate of the oscillator is increased. Similarly when the modulator plate current decreases the oscillator plate potential is reduced. Over quite a wide range, the antenna current is practically proportional to the oscillator plate potential. Therefore it is possible to make the variations in antenna current conform closely to the variations in air pressure of the sound waves reaching the microphone. The more nearly this is true, the more nearly perfect will be the reproduction of the speech.

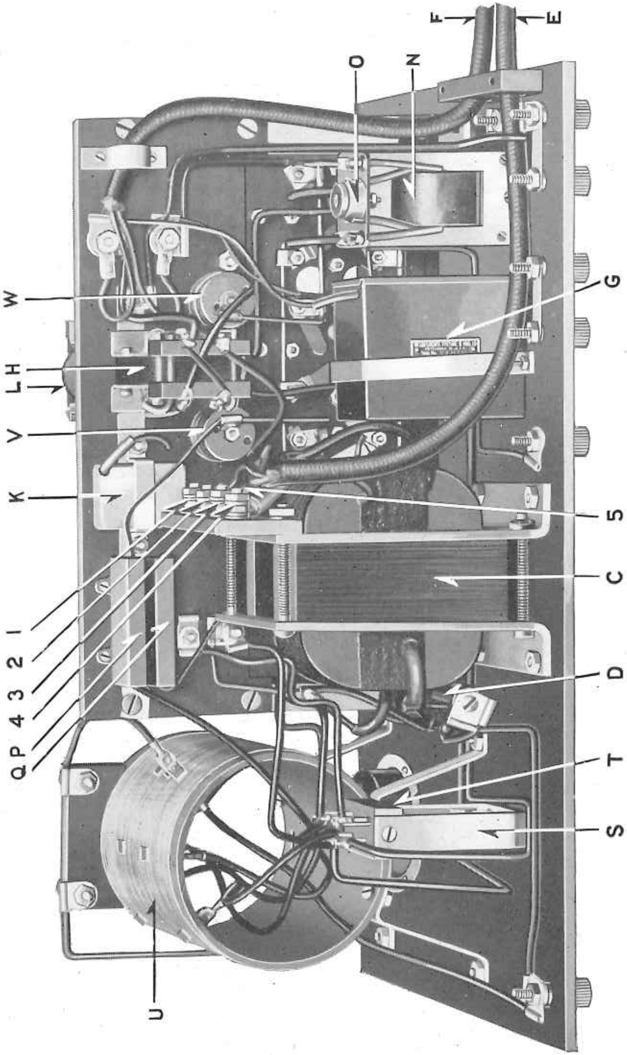

Fig. 5—Radio Tube Transmitter—A-C. Model—Bottom View

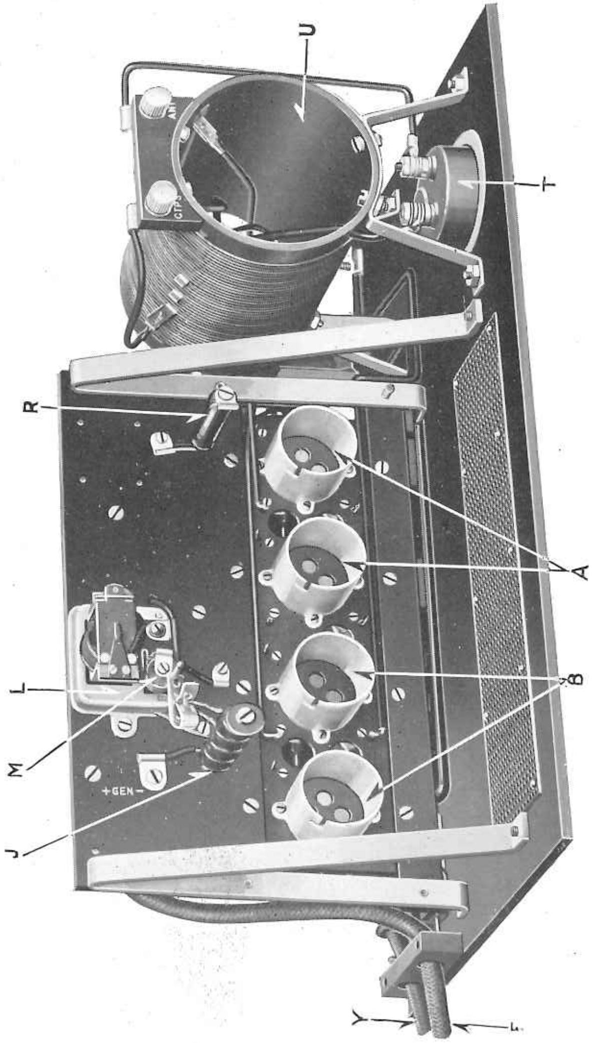

Fig 6—Radio Tube Transmitter—A-C. Model—Top View

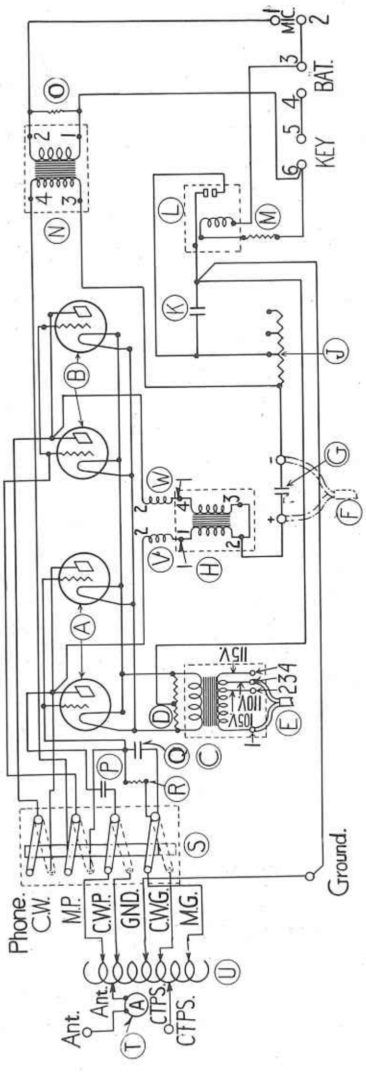

Fig. 7—Radio Tube Transmitter—A-C. Model—Diagram of Connections

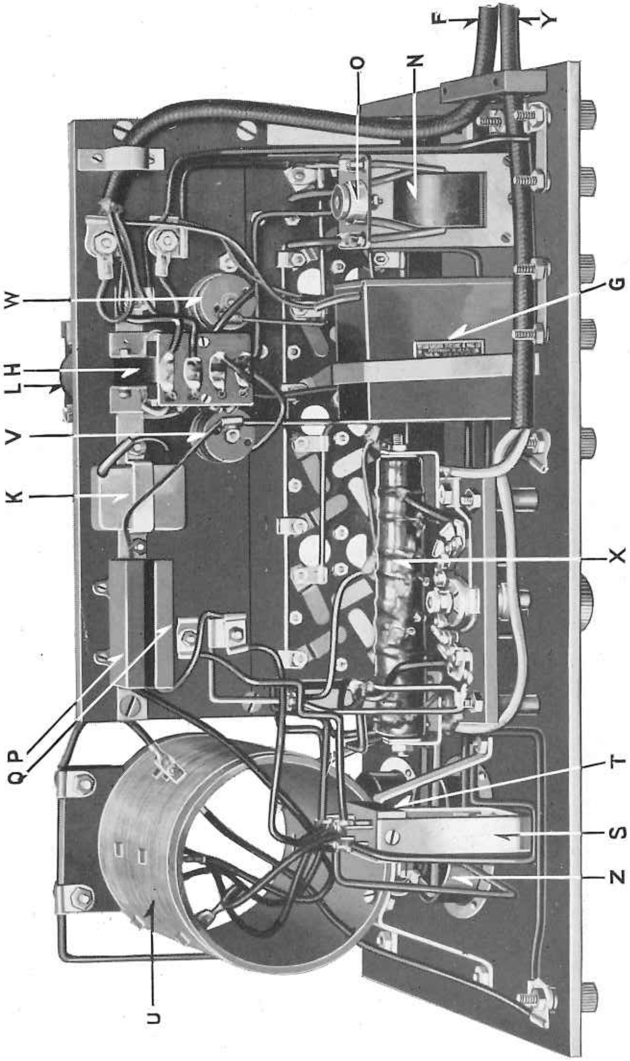

Fig. 8—Radio Tube Transmitter—D-C. Model—Bottom View

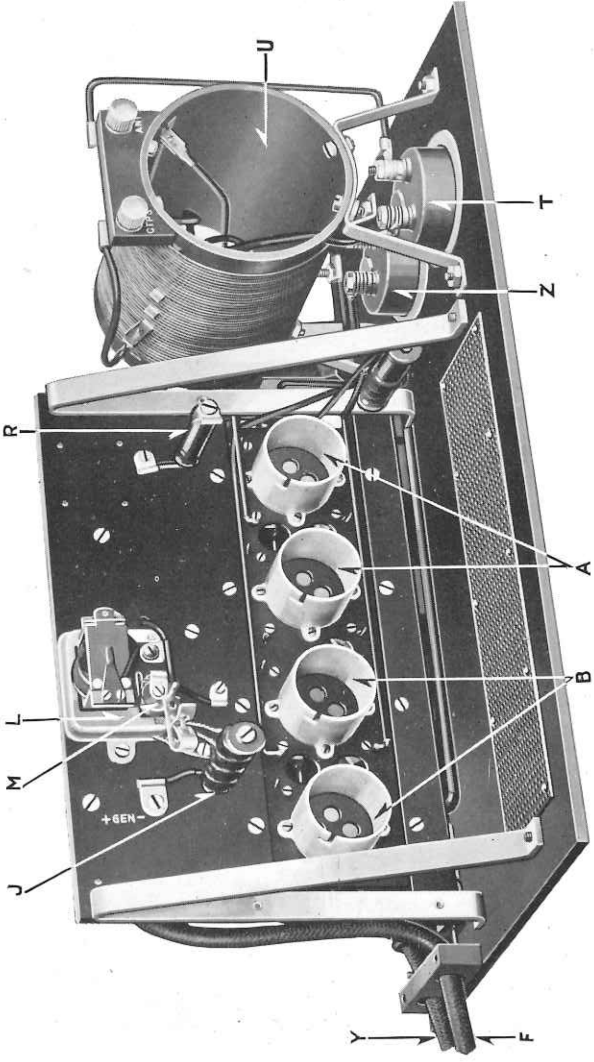

Fig. 9—Radio Tube Transmitter—D-C. Model—Top View

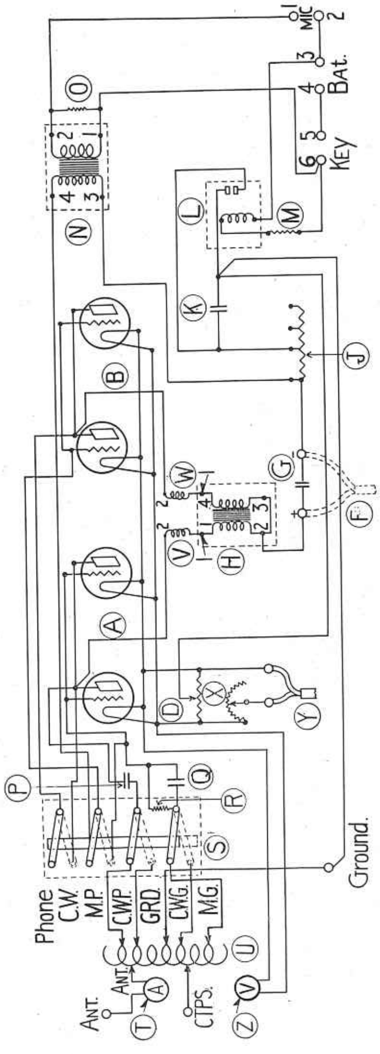

Fig. 10—Radio Tube Transmitter—D-C. Model—Diagram of Connections

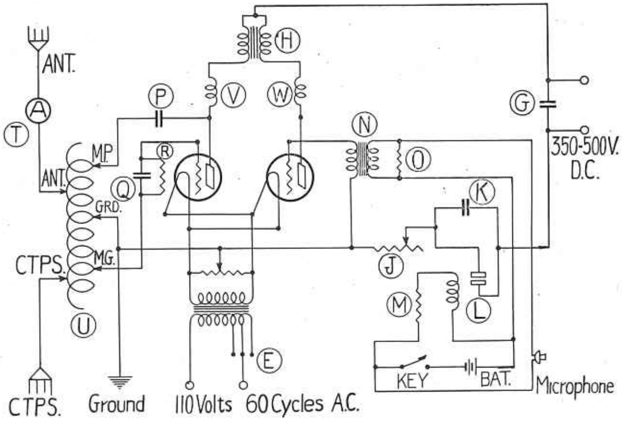

Fig. 11—Schematic [redacted] Connections
Telephone

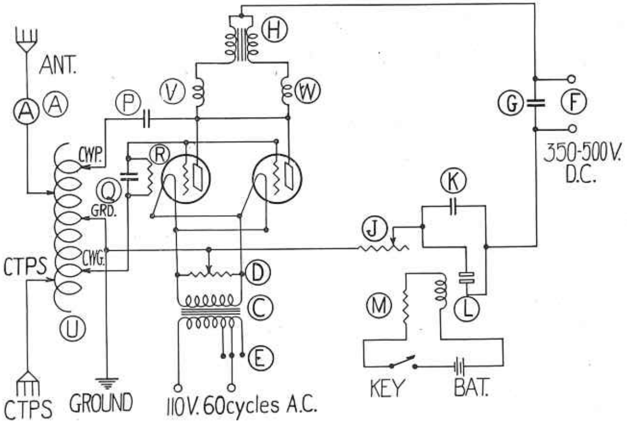

Fig. 12—Schematic ~~Telephone~~ Connections
Telegraph

RADIO COMMUNICATION LAWS OF THE UNITED STATES

The following extracts of the various regulations governing radio communication in the United States apply directly to amateur installations and are included here for convenience. The operator is advised to read them carefully and to become familiar with them as penalties are provided for infractions of these laws.

The general law covering all radio communication begins as follows: "Be it enacted, etc—That a person, company, or corporation within the jurisdiction of the United States shall not use or operate any apparatus for radio communication as a means of commercial intercourse among the several States, or with foreign nations, or upon any vessel of the United States engaged in interstate or foreign commerce, or for transmission of radiograms or signals the effect of which extends beyond the jurisdiction of the State or Territory in which the same are made, or where interference would be caused thereby with the receipt of messages or signals from beyond the jurisdiction of the said State or Territory, except under and in accordance with a license, revocable for cause, in that behalf granted by the Secretary of Commerce upon application therefor".

Amateur stations are included under the heading "General Restrictions on Private Stations" in which it is provided that": No private or commerical station not engaged in the transaction of bona fide commercial business by radio communication or in experimentation in connection with the development and manufacture of radio apparatus for commercial purposes shall use a transmitting wave length exceeding two hundred meters, or a transformer input exceeding one kilowatt, except by special authority of the Secretary of Commerce contained in the license of the station".

Secrecy of messages is covered by the following paragraph: "No person or persons engaged in or having knowledge of the operation of any station or stations, shall divulge or publish the contents of any messages transmitted or received by such station, except to the person or persons to whom the same may be directed or their authorized agent, or to another station employed to forward such message to its destination, unless legally required to do so by the court of competent jurisdiction or other competent authority".

Interference is covered by the following: "That every license granted under the provisions of this Act for the operation or use of apparatus for radio communication shall prescribe that the operator thereof shall not willfully or maliciously interfere with any other radio communication."

The following paragraph covers the requirements as to operators: "That every such apparatus shall at all times while in use and operation as aforesaid be in charge or under the supervision of a person or persons licensed for that purpose by the Secretary of Commerce."

The above extracts cover the major points of the law. In brief it may be summarized in this way: That it is against the law to operate any radio transmitter, whose signals can be heard by any other station, without a license; that amateurs are restricted to a wave length not exceeding 200 meters and a power input of not over one kilowatt; that a licensed operator is required, that all messages are secret, and that it is unlawful to cause intentional interference.

If further information is desired, the publication "Radio Communication Laws of the United States" may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

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